# Problem Set #2

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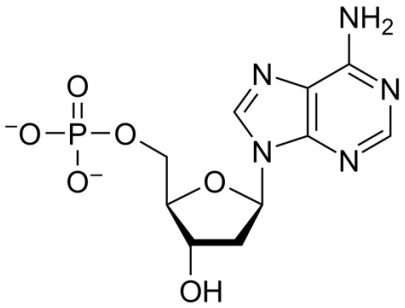
# DNA and RNA

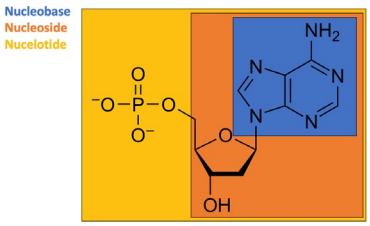
Question 1:
Give the name and the one letter abbreviation of the 5 nucleobases present in DNA and RNA and indicate which bases are used in RNA and which are used in DNA.

Answer:
Guanine (G), Cytosine (C), Thymine (T), Adenine (A), Uracil (U)
DNA: GCTA
RNA: GCUA

Question 2:
In the chemical structure below label the nucleotide, nucleoside, and nucleobase.




Answer:




Question 3:
How many phosphates can a nucleotide have?

Answer:
1, 2, **or** 3

Question 5:
How many hydrogen bonds does a GC and an AT base pair form?

Answer:
GC = 3, AT = 2

Question 6:
What primarily determines the melting temperature of DNA?

Answer:
GC content and sequence length (# of base pairs).

Question 7:
Which of these DNA strands will have the highest melting temperature?

a) AGCTGAGCTGAC
b) AGATGAGCAGAC
c) CGCTGCGCTGAC
d) TGTTGAGCAGAC

Answer: c

Question 8:
Write down the complementary DNA sequence for the sequence indicated below and label the 5’ and 3’ ends.

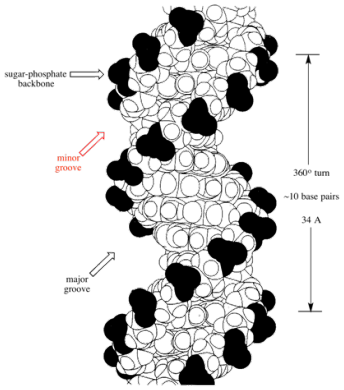
5’ AGTGTGATGA 3’

Answer:

3’ TCACACTACT 5’

Question 9:
In the image below label the following: major groove, minor groove, phosphate backbone. What structural form of DNA is this?

Answer: This is B form DNA.




Question 10:
Define the following terms: genome, chromosome, chromatin, ploidy

Answer:
**Genome:** is all the genetic information of an organism.
**Chromosome:** is a long DNA molecule with part or all of the genetic material of an organism.
**Chromatin:** is a complex of DNA and protein found in eukaryotic cells.
**Ploidy:** is the number of complete sets of chromosomes in a cell -> most common are haploid, diploid, polyploid

Question 11:
What are histones, what do they form, and what does the resulting structure do?

Answer:
Histones are proteins that form nucleosomes (one nucleosome consists of 8 histones). Histones play a role in DNA compaction/condensation because DNA is tightly wrapped around nucleosomes.

Question 12:
Give a definition for the following terms:
**Gene**
**Promoter**
**Operator**
**Enhancer/Silencer**
**Terminator**
**5' / 3' UTR**
**Exon**
**Intron**
**Poly-A tail**

Answer:

**Gene:** is a sequence of nucleotides in DNA that is transcribed to produce a functional RNA.
**Promoter:** is a sequence of DNA to which proteins bind to initiate transcription of a single RNA transcript from the DNA downstream of the promoter.
**Operator (prokaryotes):** is a place of an operon where activators or repressors bind to regulate transcription.
**Enhancer/Silencer (eukaryotes):** is a short (50–1500 bp) region of DNA that can be bound by proteins (activators or repressors) to increase or decrease the likelihood that transcription of a particular gene will occur.
**Terminator:** is a section of nucleic acid sequence that marks the end of a gene or operon in genomic DNA during transcription.
**5' / 3' UTR:** refers to either of two sections, one on each side of a coding sequence on a strand of mRNA
**Exon:** is any nucleotide sequence within a gene that is expressed or operative in the final RNA product.
**Intron:** is any nucleotide sequence within a gene that is not expressed or operative in the final RNA product.
**Poly-A tail:** is a stretch of RNA that has only adenine bases at the 3' UTR end of mRNA

Question 13:
What is a polycistronic operon and do you find these in eukaryotes or prokaryotes?

Answer:
Polycistronic operons code for multiple distinct genes which are arranged sequentially and controlled by a single promoter/terminator. They occur in prokaryotes.

Question 14:
What are the functions of the mRNA 5' cap?

Answer:
5' Cap functions:

1. Regulation of nuclear export
2. Prevention of degradation by exonucleases
3. Promotion of translation
4. Promotion of 5' proximal intron excision

Question 15:
What is spliced out during mRNA processing?

Answer:
Introns

Question 16:
What part of a tRNA is being aminoacylated?

a) The acceptor stem
b) The CCA tail
c) The anticodon loop
d) The variable loop

Answer:
b) The CCA tail.